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A-68944

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of:

STUART J. KNOWLES, ET AL.

Serial No. 09/615,294

Filed: July 13, 2000

For: METHOD OF MANUFACTURING A TUNING FORK WITH REDUCED QUADRATURE ERROR AND SYMMETRICAL MASS BALANCING

Examiner: Anthony Dexter Tugbang

Group Art Unit: 3729

Confirmation No. 4777

CERTIFICATE OF MAILING

I hereby certify that this correspondence and the attached Brief on Appeal are being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to: Mail Stop Appeal Brief - Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on August 22, 2005.

Edward S. Wright

Edward S. Wright

TRANSMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith is applicant's Brief on Appeal in this matter.

A check in the amount of $500.00 is enclosed for payment of this brief. The Commissioner is authorized to charge any additional fees or credit any overpayment to Deposit Account 50-2975, Order No. A-68944.

Respectfully submitted,

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STUART J. KNOWLES, ET AL.	Examiner: Anthony Dexter Tugbang
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BRIEF ON APPEAL

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REAL PARTY IN INTEREST

The real party in interest is BEI Technologies, Inc., to whom the application has been assigned.

RELATED APPEALS AND INTERFERENCES

None.

STATUS OF CLAIMS

The application was originally filed with Claims 1 - 13. Claims 1 - 3 were drawn to the product, and Claims 4 - 13 were drawn to the method of manufacture. Restriction was required, the method claims were elected, and the product claims were withdrawn from consideration. In an Amendment filed December 14, 2001, Claims 4 - 12 were amended, and Claims 14 - 18 were added. Claims 14 and 16 were subsequently amended in an Amendment filed February 14, 2003. Claims 4 - 18 were then allowed in an *Ex parte Quayle* action mailed August 11, 2004, in which the Examiner requested some formal amendments to the claims. In response to that action, non-elected Claims 1 - 3 were cancelled, and Claims 8, 14 and 15 were amended in an Amendment filed August 17, 2004. Four months later, "upon further consideration and careful review of the prior art", the Examiner reopened prosecution in an Office Action mailed December 17, 2004. Subsequently, in an Amendment filed March 17, 2005, Claim 6 was once again amended. In an Office Action mailed July 19, 2005, the Examiner indicated that Claim 9 is directed to allowable subject matter, and Claim 9 was written in independent form in an Amendment filed June 24, 2005.

STATUS OF AMENDMENTS

The Amendment filed June 24, 2005 was filed concurrently with the Notice of Appeal, and since Claim 9 was written in the form which the Examiner had indicated would make it allowable, and applicant would think that it would have been allowed by now. However, no action has been received on that amendment, and Claim 9 is therefore included in the claims on appeal. No other amendments have been filed since the action from which the appeal is taken

RELATED APPLICATIONS/PATENTS

U.S. Patent 6,701,785, issued March 9, 2004 on a division of the application on appeal. Its claims are directed to the product of the method which is the subject of the claims on appeal.

SUMMARY OF INVENTION

The invention is a method of manufacturing a tuning fork for use in inertial rate sensors. As discussed in the background section of applicant's disclosure (Page 1, line 14 to Page 3, line 6), such tuning forks are subject to a problem known as quadrature error which arises from variations in the fabrication of the fork. The conventional way to eliminate quadrature error is to plate masses of material (typically gold) onto the ends

of the tines and then selectively removing the material from one of the tines. That technique, however, has a significant disadvantage in that the two tines become unbalanced in mass, which degrades the performance of the sensor. The invention overcomes that problem by maintaining mass balance between the tines when quadrature error is reduced.

As discussed on Pages 4 - 7 of the specification and illustrated in Figures 1 - 3 of the drawings, the tuning fork has a pair of drive tines 11, 12 and a pair of pickup tines 13, 14 which extend in opposite directions from a central body or base 16 and are disposed symmetrically about the longitudinal axis 17 of the device. The body includes a frame 18 which surrounds a central opening 19, with a mounting pad 21 within the opening connected to the frame by relatively thin bridges 22. The tuning fork is formed as a unitary structure of a piezoelectric material such as quartz. Drive and pickup electrodes (not shown) are mounted on the tines in a conventional manner.

The free ends of drive tines 11, 12 include areas of increased lateral dimension 23, 24, with balancing masses 26 - 29 on the upper and lower surfaces of the tines in those areas. The masses are offset laterally of each other, with masses 26, 27 being positioned closer to the inner edges of the tines on the upper surfaces of the enlarged areas and masses 28, 29 being positioned closer to the outer edges of the tines on the lower surfaces. The masses can be formed by any suitable means such as plating gold on the surfaces of the tines.

To reduce quadrature error without producing an imbalance of mass between the tines, substantially equal amounts of mass are removed from opposite surfaces of the two tines. Thus, for example, removing a portion of mass element 26 from the upper surface of tine 11 will produce a reduction in quadrature signal. It will also produce an imbalance in mass between the tines. However, if a similar portion of mass element 29 is removed from the lower side of tine 12, there will be a further reduction in the quadrature signal, but the mass balance of the two tines will be preserved. This situation is illustrated in Figure 3, with the trimmed mass elements being identified by reference numerals 26a and 29a.

In the event that the removal of the two mass elements does not produce exactly equal reductions in quadrature signal, the combination of the two mass elements being removed will still reduce quadrature error without disturbing tine mass symmetry. This is an important difference between the invention and the prior art.

The determination as to which mass elements to trim is dependent upon the polarity of the quadrature signal. For example, if the quadrature signal is of positive polarity, one might trim mass 26 on the top of tine 11 and mass 29 on the bottom of tine 12. If the polarity is negative, mass 27 would then be trimmed on the top of tine 12, and mass 28 would be trimmed on the bottom of tine 11.

The mass elements can be trimmed by any suitable means such as a laser. In one presently preferred embodiment, the tines are fabricated of a material such as

crystalline quartz which is transparent to the laser beam, and all of the masses are trimmed from the same side of the fork. Thus, for example, the laser might be positioned on the front side of the fork, with the beam passing through the fork to trim elements 28, 29 on the back sides of the tines. Alternatively, if desired, the laser beam can be directed to the back sides of the tines by other means such as mirrors, or by turning the tuning fork over.

Instead of depositing masses on the tines and then removing portions of them to reduce quadrature signal, the same result can be obtained by the use of applied masses. In this case, masses are applied to opposite surfaces of the two tines to reduce quadrature error, and although the mass of the tines is increasing rather than decreasing, the symmetry of mass between the two tines is maintained.

In practical devices, it is important to adjust not only the quadrature offset in the mass trimming process, but also the resonant frequencies of both the drive mode oscillation and the pickup mode oscillation. In many instances, the difference in frequency between these two modes is critical and must be tightly controlled. In this case, mass can be removed from the tops of both tines or the bottoms of both tines in a substantially equal amounts to change the resonant frequency without affecting the quadrature offset. With the mass material being removed from the same side of both tines, the resultant twisting in the two tines tends to cancel, and quadrature is neither increased nor decreased.

If mass is removed, the resonant frequency will increase, and if mass is added, the resonant frequency will decrease. By trimming the mass on the drive tines, the frequency of the drive mode will be preferentially affected relative to the frequency of the pickup mode, whereby the difference in frequency between the two modes can be adjusted independently. A similar adjustment of the pickup mode frequency can be made independently of the drive mode by trimming mass from or adding mass to the pickup tines. For this purpose, masses 31, 32 are provided in enlarged areas 33, 34 at the free ends of pickup tines 13, 14.

It is not necessary that the two tines be substantially equal in mass and stiffness prior to adjustment for quadrature offset. If there is an imbalance between the tines, either by design or by errors in fabrication, that imbalance can be corrected by first trimming the mass on one of the tines to eliminate the imbalance, and then trimming equally from both tines for subsequent adjustment. In this way, an inherently asymmetric fork can be corrected a part of the quadrature reduction and frequency adjustment process.

ISSUES

Whether the Examiner has erred in rejecting Claims 4 - 8 and 10 - 18 under 35 U.S.C. §102 or 35 U.S.C. §103 as being anticipated by or obvious from Macy (U.S. 5,522,249).

GROUPING OF CLAIMS

It is not acceptable to applicant to have the claims stand or fall together within the groups in which they have been rejected. Different claims include an different limitations, and the Board could very well find that at least some of the claims are directed to patentable subject matter even if it were to affirm the Examiner's rejection of others.

ARGUMENT

Section 102

In order to be a proper basis for rejection under 35 U.S.C. §102, a reference must show each and every element of the claimed invention, which Macy clearly does not do. There is a fundamental difference between applicant's invention and the teachings of Macy, which the Examiner apparently does not understand.

While applicant's invention and Macy may both be concerned with the elimination of quadrature error, they do so in different ways. In Macy, the pickup electrodes are trimmed to produce an electrical null in the quadrature signal, whereas in applicant's invention balancing masses are utilized to eliminate quadrature vibration and to maintain a balance in mass between the tines. One is an electrical technique; the other is mechanical.

The electrical balancing technique of Macy is quite different than applicant's invention. In the single-ended tuning fork of Macy, piezoelectrically induced drive charge is present on the pickup electrodes. If this charge is not perfectly symmetrical in its distribution on the various pickup electrodes, there will be a net quadrature signal in the output since the drive charge signal is in quadrature phase relation to the rotation-induced Coriolis signal. By trimming away electrode area, an intentional change in the electrode symmetry is created to produce an electrical nulling of the quadrature signal.

Moreover, contrary to the Examiner's suggestion, the pickup electrodes in Macy are not balancing masses. Their function is to provide electrically conductive regions for sensing piezoelectrically induced charge, and their mass is insignificant. Such electrodes are typically only 100 - 200 nm thick, whereas balancing masses as employed in applicant's invention may be as thick as 10,000 nm and a relatively heavy metal such as gold.

The location of the pickup electrodes relatively close to the base of the tines in Macy also makes their mass less significant since they are farther away from the free ends of the tines which move with significantly more velocity than the areas near the base.

In contrast, in applicant's invention, there is a true mechanical balancing in which the mechanical properties of the tines are altered such that the actual quadrature displacement in the pickup mode of vibration is reduced or eliminated.

Macy was also cited in the divisional application on which U.S. Patent 6,701,785 has now issued, and the Examiner in that application initially mischaracterized the electrodes as balancing masses and made arguments similar to those made by the Examiner in this application. Ultimately, however, the claims in that application were

allowed when applicant pointed out that the electrodes in Macy are not balancing masses and that the balancing in Macy is electrical, not mechanical. These differences are even more significant with the method claims than with the product claims because they involve not only the use of the balancing masses but also the manner in which they are trimmed.

Claim 4 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, and using balancing masses on the front surface of one tine and the rear surface of the other tine to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. The electrodes shown in Macy are not balancing masses. They are not used to maintain a balance in mass between the tines, and there is no suggestion of using balancing masses on the front surface of one tine and the rear surface of the other. Likewise, there is no suggestion of using balancing masses to reduce quadrature error. Hence, Macy clearly does not anticipate the invention.

Claim 5 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, applying mass elements to the tines, and removing portions of the mass elements from the front surface of one tine and from the rear surface of the other to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. Macy does not teach or suggest the application of balancing masses, and it certainly does not show or suggest removing portions of the masses from the front surface of one tine and the rear surface of the other, and it likewise does not teach or suggest the removal of mass from such surfaces to reduce quadrature displacement or to maintain a balance in mass. Hence, Macy does not anticipate Claim 5 either.

Claim 6 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, and adding mass elements to the front surface of one tine and the rear surface of the other tine to eliminate quadrature displacement in the tines and maintained a balance in mass between the tines. Here again, Macy does not teach or suggest the addition of mass elements to the front surface of one tine and the rear surface of the other, nor does it show or suggest the addition of mass elements to eliminate quadrature error or to maintain a balance in mass between the tines. Hence, it does not anticipate Claim 6.

Claim 7 distinguishes over Macy in calling for the steps of forming a pair of elongated tines having free ends of increased lateral dimension with laterally offset balancing masses on opposite sides of the tines near the free ends, and adjusting the balancing masses on opposite sides of the two tines to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. Macy does not show or suggest the formation of tines having either free ends of increased lateral dimension or laterally offset balancing masses on opposite sides of the tines near the free ends, nor does it show or suggest adjusting the balancing masses on opposite sides of the

two tines to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. Without those steps, it does not anticipate Claim 7.

Claims 8 and10 depend from Claim 7 and are directed to patentable subject matter for the same reasons as their parent claim. In addition, Claim 7 further distinguishes over Macy in specifying that the balancing masses are adjusted by removing substantially equal amounts of the balancing masses from the opposite sides of the tines, and Claim 10 further distinguishes in calling for the step of removing substantially equal amounts of the balancing masses from same sides of the tines to adjust the drive mode frequency of the tuning fork. Those steps are not found in Macy, and without them, Macy does not anticipate.

Claim 9 distinguishes over Macy in calling for the steps of forming a pair of elongated tines with free ends of increased lateral dimension of a material which is transparent to a laser beam, forming laterally offset balancing masses on opposite sides of the tines near the free ends, and trimming the balancing mass on one side of one of the tines by passing the laser beam through the tine to the balancing mass. Since the Examiner has indicated that Claim 9 would be allowable if rewritten in independent form, and it is now in that form, applicant trusts that it will be allowed.

Claim 11 distinguishes over Macy in calling for the steps of forming an elongated pair of drive tines having front and rear surfaces, forming a pair of pickup tines having front and rear surfaces, applying balancing masses to the front and rear surfaces of the drive tines, and trimming the balancing masses on opposite sides of the drive tines to reduce quadrature displacement without affecting mass balance between the drive tines. Macy does not show or suggest either the application of balancing masses to the front and rear surfaces of drive tines or trimming balancing masses on opposite sides of the drive tines to reduce quadrature displacement without affecting mass balance between the drive tines. Hence, it does not anticipate.

Claims 12 and 13 depend from Claim 11 and are directed to patentable subject matter for the same reasons as their parent claim. In addition, Claim 12 further distinguishes in calling for the step of trimming the masses on same sides of the drive tines to adjust the drive mode frequency of the tuning fork, and Claim 13 further distinguishes in calling for the steps of providing masses on the pickup tines, and trimming the masses on the pickup tines to adjust the pickup mode frequency of the tuning fork. Without those steps, Macy does not anticipate.

Claim 14 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, applying balancing masses to the front and rear surfaces of the tines, trimming the balancing masses if necessary to provide a balance in mass between the two tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the tines and from the rear surface of the other tine to reduce

quadrature displacement in the tines and maintain the balance in mass between tines. Without those steps, Macy does not anticipate.

Claims 15 depends from Claim 14 and is directed to patentable subject matter for the same reasons as its parent claim. In addition, it further distinguishes in calling for the step of removing substantially equal amounts of the balancing masses from same sides of the tines to adjust the drive mode frequency of the tuning fork.

Claim 16 distinguishes over Macy in calling for the steps of forming elongated pairs of drive and pickup tines which have front and rear surfaces and extend in opposite directions from a central body, applying balancing masses to the front and rear surfaces of the drive tines, trimming the balancing masses if necessary to provide a balance in mass between the drive tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the drive tines and from the rear surface of the other drive tine to reduce quadrature displacement in the drive tines and maintain the balance in mass between them. Macy does not show or suggest applying balancing masses to the front and rear surfaces of the drive tines, trimming the balancing masses if necessary to provide a balance in mass between the drive tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the drive tines and from the rear surface of the other drive tine to reduce quadrature displacement in the drive tines and maintain the balance in mass between the tines. Without those steps, Macy certainly does not anticipate.

Claims 17 and 18 depend from Claim 16 and are directed to patentable subject matter for the same reasons as their parent claim. In addition, Claim 17 further distinguishes in calling for the step of removing substantially equal amounts of the balancing masses from same sides of the drive tines to adjust the drive mode frequency of the tuning fork, and Claim 18 further distinguishes in calling for the steps of applying balancing masses to the pickup tines and removing substantially equal amounts of the balancing masses from same sides of the pickup tines to adjust the pickup mode frequency of the tuning fork.

Section 103

In support of the obviousness rejection, the Examiner simply argues that if removing or adjusting the balancing masses on "opposite sides" of the tines, the "same sides" of the tines or from the "front surface of one tine and the rear surface of the other" is not inherent in Macy, then it would have been obvious to do so because Macy because "Macy attempts to solve his very own problem of symmetry and balance with balancing of masses or mass elements (electrodes)", citing Col. 4, lines 46 *et seq.* of Macy. In so doing, the Examiner has failed to address a single one of the 14 or 15 claims which are included in the rejection. Moreover, the argument is based on the mischaracterization of the electrodes as balancing masses, and it continues to overlook or ignore the difference between mass balancing and electrical balancing. Furthermore, it overlooks

or ignores the fact that it is very important that the masses be removed from the surfaces specified and not others.

The portion of Macy cited by the Examiner (Col. 4, line 46 *et seq.*) is not concerned with mass balancing at all, but rather with arranging the electrical leads on the tines in a symmetrical manner in order to minimize capacitive coupling between them.

The simple fact is that Macy does not teach or even remotely suggest the use or removal of balancing masses in the manner of applicant's invention, and it certainly does not suggest removing such masses from the specific surfaces set forth in the claims.

As discussed above, Claim 4 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, and using balancing masses on the front surface of one tine and the rear surface of the other tine to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. The electrodes shown in Macy are not balancing masses. They are not used to maintain a balance in mass between the tines, and there is no suggestion of using balancing masses on the front surface of one tine and the rear surface of the other. Likewise, there is no suggestion of using balancing masses to reduce quadrature error. Those steps are not inherent in Macy, they even remotely suggested by it, and the Examiner has failed to make even a *prima facie* case of obviousness.

Claim 5 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, applying mass elements to the tines, and removing portions of the mass elements from the front surface of one tine and from the rear surface of the other to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. Macy does not teach or suggest the application of balancing masses, and it certainly does not show or suggest removing portions of the masses from the front surface of one tine and the rear surface of the other, and it likewise does not teach or suggest the removal of mass from such surfaces to reduce quadrature displacement or to maintain a balance in mass. Here again, the steps are not inherent in Macy, they are not even remotely suggested by it, and the Examiner has once again failed to make a *prima facie* case of obviousness.

Claim 6 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, and adding mass elements to the front surface of one tine and the rear surface of the other tine to eliminate quadrature displacement in the tines and maintained a balance in mass between the tines. Here again, Macy does not teach or suggest the addition of mass elements to the front surface of one tine and the rear surface of the other, nor does it show or suggest the addition of mass elements to eliminate quadrature error or to maintain a balance in mass between the tines. Once again, the Examiner has failed to make even a *prima facie* case of obviousness.

Claim 7 distinguishes over Macy in calling for the steps of forming a pair of elongated tines having free ends of increased lateral dimension with laterally offset balancing masses on opposite sides of the tines near the free ends, and adjusting the balancing masses on opposite sides of the two tines to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. Macy does not show or suggest the formation of tines having either free ends of increased lateral dimension or laterally offset balancing masses on opposite sides of the tines near the free ends, nor does it show or suggest adjusting the balancing masses on opposite sides of the two tines to reduce quadrature displacement in the tines and maintain a balance in mass between the tines. Without those steps, there is no basis for the rejection which the Examiner has made.

Claims 8 and10 depend from Claim 7 and are directed to patentable subject matter for the same reasons as their parent claim. In addition, Claim 7 further distinguishes over Macy in specifying that the balancing masses are adjusted by removing substantially equal amounts of the balancing masses from the opposite sides of the tines, and Claim 10 further distinguishes in calling for the step of removing substantially equal amounts of the balancing masses from same sides of the tines to adjust the drive mode frequency of the tuning fork. Those steps are not found in Macy, and the Examiner has once again failed to make even a *prima facie* case of obviousness.

Claim 9 distinguishes over Macy in calling for the steps of forming a pair of elongated tines with free ends of increased lateral dimension of a material which is transparent to a laser beam, forming laterally offset balancing masses on opposite sides of the tines near the free ends, and trimming the balancing mass on one side of one of the tines by passing the laser beam through the tine to the balancing mass. Since the Examiner has indicated that Claim 9 would be allowable if rewritten in independent form, and it is now in that form, applicant trusts that it will be allowed.

Claim 11 distinguishes over Macy in calling for the steps of forming an elongated pair of drive tines having front and rear surfaces, forming a pair of pickup tines having front and rear surfaces, applying balancing masses to the front and rear surfaces of the drive tines, and trimming the balancing masses on opposite sides of the drive tines to reduce quadrature displacement without affecting mass balance between the drive tines. Macy does not show or suggest either the application of balancing masses to the front and rear surfaces of drive tines or trimming balancing masses on opposite sides of the drive tines to reduce quadrature displacement without affecting mass balance between the drive tines. Here again, the Examiner has once again failed to make even a *prima facie* case of obviousness.

Claims 12 and 13 depend from Claim 11 and are directed to patentable subject matter for the same reasons as their parent claim. In addition, Claim 12 further distinguishes in calling for the step of trimming the masses on same sides of the drive tines to adjust the drive mode frequency of the tuning fork, and Claim 13 further

distinguishes in calling for the steps of providing masses on the pickup tines, and trimming the masses on the pickup tines to adjust the pickup mode frequency of the tuning fork. Without those steps, there is no basis for the rejection which the Examiner has made.

Claim 14 distinguishes over Macy in calling for the steps of forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, applying balancing masses to the front and rear surfaces of the tines, trimming the balancing masses if necessary to provide a balance in mass between the two tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the tines and from the rear surface of the other tine to reduce quadrature displacement in the tines and maintain the balance in mass between tines. Those steps are not even remotely suggested by Macy, and once again there is not even a case of *prima facie* obviousness.

Claims 15 depends from Claim 14 and is directed to patentable subject matter for the same reasons as its parent claim. In addition, it further distinguishes in calling for the step of removing substantially equal amounts of the balancing masses from same sides of the tines to adjust the drive mode frequency of the tuning fork. This likewise is not even remotely suggested by Macy, and there is no obviousness.

Claim 16 distinguishes over Macy in calling for the steps of forming elongated pairs of drive and pickup tines which have front and rear surfaces and extend in opposite directions from a central body, applying balancing masses to the front and rear surfaces of the drive tines, trimming the balancing masses if necessary to provide a balance in mass between the drive tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the drive tines and from the rear surface of the other drive tine to reduce quadrature displacement in the drive tines and maintain the balance in mass between them. Macy does not show or suggest applying balancing masses to the front and rear surfaces of the drive tines, trimming the balancing masses if necessary to provide a balance in mass between the drive tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the drive tines and from the rear surface of the other drive tine to reduce quadrature displacement in the drive tines and maintain the balance in mass between the tines. With no suggestion of those steps, there is no obviousness.

Claims 17 and 18 depend from Claim 16 and are directed to patentable subject matter for the same reasons as their parent claim. In addition, Claim 17 further distinguishes in calling for the step of removing substantially equal amounts of the balancing masses from same sides of the drive tines to adjust the drive mode frequency of the tuning fork, and Claim 18 further distinguishes in calling for the steps of applying balancing masses to the pickup tines and removing substantially equal amounts of the balancing masses from same sides of the pickup tines to adjust the pickup mode frequency of the tuning fork. Here again, those steps are not even remotely suggested by Macy, and there is no obviousness.

SUMMARY AND CONCLUSION

It is respectfully submitted that the rejection(s) which the Examiner has made cannot be sustained and that the action of the Examiner should be reversed.

Respectfully submitted,

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The Claims on Appeal

4. In a method of manufacturing a tuning fork for use in an inertial rate sensor, the steps of: forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, and using balancing masses on the front surface of one tine and the rear surface of the other tine to reduce quadrature displacement in the tines and maintain a balance in mass between the tines.

5. In a method of manufacturing a tuning fork for use in an inertial rate sensor, the steps of: forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, applying mass elements to the tines, and removing portions of the mass elements from the front surface of one tine and from the rear surface of the other to reduce quadrature displacement in the tines and maintained a balance in mass between the tines.

6. In a method of manufacturing a tuning fork for use in an inertial rate sensor, the steps of: forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, and adding mass elements to the front surface of one tine and the rear surface of the other tine to eliminate quadrature displacement in the tines and maintain a balance in mass between the tines.

7. In a method of manufacturing a tuning fork for use in an inertial rate sensor, the steps of: forming a pair of elongated tines having free ends of increased lateral dimension with laterally offset balancing masses on opposite sides of the tines near the free ends, and adjusting the balancing masses on opposite sides of the two tines to reduce quadrature displacement in the tines and maintain a balance in mass between the tines.

8. The method of Claim 7 wherein the balancing masses are adjusted by removing substantially equal amounts of the balancing masses from the opposite sides of the tines.

9. A method of manufacturing a tuning fork for use in an inertial rate sensor, comprising the steps of: forming a pair of elongated tines with free ends of increased lateral dimension of a material which is transparent to a laser beam, forming laterally offset balancing masses on opposite sides of the tines near the free ends, and trimming the balancing mass on one side of one of the tines by passing the laser beam through the tine to the balancing mass.

10. The method of Claim 7 further including the step of removing substantially equal amounts of the balancing masses from same sides of the tines to adjust the drive mode frequency of the tuning fork.

11. In a method of manufacturing a tuning fork for use in an inertial rate sensor, the steps of: forming an elongated pair of drive tines having front and rear surfaces, forming a pair of pickup tines having front and rear surfaces, applying balancing masses

to the front and rear surfaces of the drive tines, and trimming the balancing masses on opposite sides of the drive tines to reduce quadrature displacement without affecting mass balance between the drive tines.

12. The method of Claim 11 further including the step of trimming the masses on same sides of the drive tines to adjust the drive mode frequency of the tuning fork.

13. (Original) The method of Claim 11 further including the steps of providing masses on the pickup tines, and trimming the masses on the pickup tines to adjust the pickup mode frequency of the tuning fork.

14. In a method of manufacturing a tuning fork for use in an inertial rate sensor, the steps of: forming a pair of elongated tines which have front and rear surfaces and are disposed symmetrically about an axis, applying balancing masses to the front and rear surfaces of the tines, trimming the balancing masses if necessary to provide a balance in mass between the two tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the tines and from the rear surface of the other tine to reduce quadrature displacement in the tines and maintain the balance in mass between tines.

15. The method of Claim 14 further including the step of removing substantially equal amounts of the balancing masses from same sides of the tines to adjust the drive mode frequency of the tuning fork.

16. In a method of manufacturing a tuning fork for use in an inertial rate sensor, the steps of: forming elongated pairs of drive and pickup tines which have front and rear surfaces and extend in opposite directions from a central body, applying balancing masses to the front and rear surfaces of the drive tines, trimming the balancing masses if necessary to provide a balance in mass between the drive tines, and thereafter removing substantially equal amounts of the balancing masses from the front surface of one of the drive tines and from the rear surface of the other drive tine to reduce quadrature displacement in the drive tines and maintain the balance in mass between them.

17. The method of Claim 16 further including the step of removing substantially equal amounts of the balancing masses from same sides of the drive tines to adjust the drive mode frequency of the tuning fork.

18. The method of Claim 16 further including the steps of applying balancing masses to the pickup tines, and removing substantially equal amounts of the balancing masses from same sides of the pickup tines to adjust the pickup mode frequency of the tuning fork.